Summary of "Hospitalization for Community-Acquired Pneumonia in Alberta Patients With Human Immunodeficiency Virus Infection: A Case Control Study"

By D. Johnson, K.C. Carriere, S. Houston, Y. Jin, G. Predy, J. Gill, S. Shafran, and T.J. Marrie

Purpose

In 1997, highly active anti-retroviral therapy (HAART) became available as multiple drug regimens effective against HIV. Such therapy is capable of suppressing the HIV virus and may decrease the rate of hospitalization for bacterial pneumonia. The objective of this study was to determine if outcomes of pneumonia in HIV positive persons differed from those who were HIV negative with pneumonia in the years before and after anti-retroviral therapy became available in Alberta.

Approach

Hospital abstracts were used to study pneumonia among HIV positive persons compared to similar patients without HIV in Alberta from April 1, 1994 until March 31, 1999.

Key findings

The following are the key findings:

- Hospitalizations for community-acquired pneumonia decreased for those with AIDS and increased for those with non-AIDS HIV during the study period.
- AIDS patients (n=130) admitted to hospital for community-acquired pneumonia had a longer hospital length of stay (three times the median for similar HIV negative patients) and had greater in-hospital and one year mortality (three and ten times the rate for similar HIV negative patients).
- Non-AIDS HIV patients (n= 46) admitted to hospital for community-acquired pneumonia had a longer hospital length of stay (two times the median for similar HIV negative patients) and had greater one year mortality (four times the rate for similar HIV negative patients).
- The in-hospital mortality rate for the AIDS patients was 21.2 percent during the first three years of the study and decreased to 8.7 percent in the last two years of the study (after introduction of HAART therapy).
- The one-year mortality rate for the AIDS patients was 64.3 percent during the first three years of the study and decreased to 40.7 percent in the last two years of the study (after introduction of HAART therapy).

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Conclusions

The outcomes for community-acquired pneumonia were worse for those with non-AIDS HIV and AIDS compared to similar patients after controlling for the severity of pneumonia and presence of other illness. In those with AIDS, both hospitalizations for pneumonia and mortality rate have decreased over the 1994 and 1999 time period when anti-retroviral therapy became available in Alberta.

For more information

Copies of the report are available from the
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Alberta Centre for Health Services Utilization Research

The Alberta Centre for Health Services Utilization Research is a joint initiative between the University of Alberta and the University of Calgary, funded by Alberta Health and Wellness. The Centre conducts studies of how health services are used and delivered to inform health policy development and management of health services delivery.

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Hospitalization for Community-Acquired Pneumonia in Alberta Patients With Human Immunodeficiency Virus Infection : A Case Control Study

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SUMMARY

In 1997, highly active antiretroviral therapy (HAART) became available as multiple drug regimens effective against human immunodeficiency virus. This therapy is capable of suppressing the human immunodeficiency virus and may decrease the rate of hospitalization for bacterial pneumonia. Our objective was to determine if outcomes of pneumonia in human immunodeficiency virus positive persons differed from those who were human immunodeficiency virus negative with pneumonia in the years before and after antiretroviral therapy became available in Alberta. We used hospital abstracts to study pneumonia among human immunodeficiency virus positive persons compared to similar patients without human immunodeficiency virus in Alberta from April 1, 1994 until March 31, 1999.

We found that hospitalizations for community-acquired pneumonia decreased for those with AIDS and increased for those with non-AIDS human immunodeficiency virus during the study period. AIDS status (n = 130) identified patients admitted for community-acquired pneumonia who had three times higher odds for a longer hospital length of stay and who had three and ten times higher odds for excess in-hospital and one-year mortality, respectively, than their matched controls. Similarly, non-AIDS human immunodeficiency virus status (n = 46) identified patients admitted for community-acquired pneumonia who had twice higher odds for a longer hospital length of stay and who had four times higher odds for excess one-year mortality than their matched controls. The in-hospital and one-year mortality rate for the AIDS patients was 21.2 percent and 64.3 percent respectively during the first three years and decreased to 8.7 percent and 40.7 percent, respectively, in the last two years of the study.

We concluded that the outcomes for community-acquired pneumonia were worse for those with non-AIDS human immunodeficiency virus / AIDS after matching for age and sex and controlling for severity of illness and comorbidity. In those with AIDS, both hospitalizations for pneumonia and mortality rate have decreased over the 1994 and 1999 time period when antiretroviral therapy became available in Alberta.

INTRODUCTION

In 1981, pneumonia due to Pneumocystis carinii (PCP) among young men heralded the onset of infection with the human immunodeficiency virus [1]. Since then it has been recognized that infection with this virus leads to depletion of CD 4 lymphocytes and that a CD 4 count of < 200 per microliter is a risk factor for the development of Pneumocystis carinii [2]. The next important event was the recognition that prophylaxis with trimethoprim-sulphamethoxazole was effective in preventing this infection [3]. It was also recognized that the rate of pneumonia was very high among human immunodeficiency virus infected persons – 5.5 episodes per 100 person years compared with a rate of 0.9 per 100 person years among human immunodeficiency virus negative persons [4]. Furthermore, there was an incremental increase in the rate of pneumonia as the CD 4 count declined. Thus for CD 4 counts of > 500, 200 – 500 and < 200, the rates of pneumonia were 2.3, 6.8, 10.8 per 100 person years, respectively [4]. In April, 1997, highly active antiretroviral therapy (HAART) became available in Alberta as multiple drug regimens effective against human immunodeficiency virus in Alberta. Such therapy is capable of suppressing the viral load and leading to an increase in the CD 4 count [5]. Studies comparing the pulmonary manifestations of human immunodeficiency virus infection pre- and post-introduction of highly active antiretroviral therapy have found a reduction in the rate of Pneumocystis carinii [6, 7] and an increase [6] or a stable rate of bacterial pneumonia [7]. We used an administrative data set to study pneumonia patients requiring hospitalization among human immunodeficiency virus positive persons in Alberta from April 1, 1994 until March 31, 1999. Our objectives were to determine if outcomes of pneumonia in human immunodeficiency virus positive persons differed from those who were human immunodeficiency virus negative with pneumonia. To accomplish the latter objective, we matched each human immunodeficiency virus positive patient with pneumonia with four human immunodeficiency virus negative patients with pneumonia by age and sex.

METHODS

The administrative health service database was used and the analysis was done within the protected environment of Alberta Health and Wellness, which is governed by provincial legislative guidelines on the confidentiality of health information.

Inclusion Criteria:

Canadian Institute for Health Information's (CIHI) Inpatient Discharge Abstract Database (DAD) for the province of Alberta from April 1, 1994 to March 31, 1999 was used. Community-acquired pneumonia was defined as the most responsible diagnosis (MRD) or any of the other fifteen diagnosis codes defined to be Type 1 (pre-admit comorbidity) with the ICD-9-CM values of 480.x to 487.x (pneumonia) or 507.x (aspiration pneumonia) excluding 484.x (pneumonia of infectious diseases classified elsewhere) [8, 9]. Symptomatic Human Immunodeficiency Virus infection was defined as ICD-9-CM value of 042 in any of the sixteen diagnosis codes. Asymptomatic Human Immunodeficiency Virus infection was defined as ICD-9-CM value of V08 in any of the sixteen diagnosis codes. We used a one to four matched case-control study. The data were matched according to age, sex, and the year of diagnosis of pneumonia. First, we identified AIDS or non-AIDS human immunodeficiency virus patients in our entire cohort. We then divided the data to identify non-AIDS human immunodeficiency virus patients. Then, for each AIDS / non-AIDS human immunodeficiency virus case, we randomly sampled control patients who matched the case patient by age, sex, and the year of diagnosis of pneumonia.

Exclusion Criteria:

1) Not an Alberta resident or not treated in an Alberta acute care facility;
2) Adjacent diagnosis related group (ADRG) defining hospitalization for a surgical procedure;
3) Any previous hospitalization within ten days of incident pneumonia case.

Severity of illness was defined as any of:

- Transfer from another acute care facility as defined by re-admission to hospital for the diagnosis of pneumonia within forty-eight hours of previous discharge;
- Special/intensive care unit admission (defined by each hospital);
- Diagnosis code of respiratory failure or arrest (ICD-9-CM 518.81, 799.1);
- Diagnosis code of hypotension or shock (ICD-9-CM 458.xx, 785.5x);
- Procedure code for ventilation greater than ninety-six hours (ICD-9-CM 96.72);
- Procedure code for dialysis (ICD-9-CM 39.95, 54.98).

Comorbidity:

Charlson's comorbidities was calculated using established definitions [10, 11]. Length of stay was calculated as days between discharge and admission date. All active hospital acute care beds in each year per resident region were surveyed and maintained in the provincial databases. Export was primary admission to a hospital not within region of residence.

Hospital Costs:

Inpatient costing per resource group number (RGN) was calculated using the provincially approved methodology as set forth by the Provincial Costing Project and in accordance with the Provincial and National Management Information Systems guidelines [12, 13]. Total costs combine allocation and assignment of all direct and indirect costs associated with an inpatient encounter from the time a patient is admitted to the hospital to the time they are discharged. All costs were estimated in 1998/99 and assumed similar for all the study years. The quality of the data reporting of costs in Alberta has been highly ranked by the Canadian Institute for Health Information [14]. As such, the methodological issues that arise around collection of cost data in the United States of America [15], in part due to the use of charges rather than costs, and for centres in Canada which cost admissions on the basis of "case-mix grouping", do not arise with the majority of the cost data considered in this analysis.

Mortality:

Vital statistics declaration of death certificates were merged with the Alberta Health Care Premium Registry databank in order to determine de-registration from the plan. Reliability of linkage was high (99.5 percent) as verified by comparing in-hospital deaths recorded by hospital chart extraction to Alberta Health Care Premium Registry death derived from vital statistics.

Outcomes Used in Analyses:

- number of patients with Human Immunodeficiency Virus Infection in Alberta;
- hospital length of stay greater than the median (greater than six days);
- hospital cost greater than the median (greater than $637.72);
- in-hospital death;
- one-year mortality per separation (excluding in-hospital deaths);
- thirty-day all cause hospital re-admission.

Registries of the number of human immunodeficiency virus positive patients are kept at the Human Immunodeficiency Virus clinic in Calgary and

Edmonton. Patients who were human immunodeficiency virus positive and those who met the revised surveillance case definition for AIDS in Canada [16] were recorded on April 1 each year. These registries account for most but not all of the human immunodeficiency virus positive patients in Alberta. These registry numbers were used as the denominator to calculate pneumonia attack rates.

STATISTICS

Crude separation rate and confidence intervals for community-acquired pneumonia were calculated from April 1, 1994 to March 31, 1999. The denominator was all those with positive non-AIDS human immunodeficiency virus or AIDS status that were registered at either the Calgary or Edmonton clinics. Because of the low number of separations and introduction of highly active antiretroviral therapy in April, 1997, we aggregated data from April 1, 1994 to March 31, 1997 and April 1, 1997 to March 31, 1999.

To analyze the case-control data, we used the conditional logistic analysis tool, LogXact V. 2.0 (1996) by Cytel Software Corporation, Cambridge, MA., United States of America. Covariates were diagnosis of AIDS, diagnosis of human immunodeficiency virus, year, age, sex, exported case (i.e. service region not equal to recipient region), urban or non-urban resident region, hospital transfer, special/intensive care unit admission, diagnosis code of respiratory failure/arrest, diagnosis code of hypotension/shock, procedure code for ventilation greater than ninety-six hours , procedure code for dialysis, and number of comorbid diagnosis (0, 1, 2, > 2). The unit of analysis was hospital separation with some patients being hospitalized on multiple occasions per year. In previous related studies, we verified that ignoring correlation in multiple occasions per persons did not result in any loss in information. Therefore, we report results of a standard conditional logistic model [17, 18].

RESULTS

Table 1 shows the demographic data for the three populations: those with AIDS (n = 130), those with non-AIDS human immunodeficiency virus infection (n = 46) and the control group – those without human immunodeficiency virus infection (n = 704). Figure 1 shows the yearly discharge rate for community-acquired pneumonia in patients with non-AIDS human immunodeficiency virus / AIDS. Estimating the prevalence of those with AIDS from metropolitan clinic registries, we found that the rate of hospitalization for community-acquired pneumonia decreased in those with AIDS (from 15.3 percent [95% CI 12.8- 18.2] in the first three years of the study to 9.9 percent [95% CI 7.0 –12.4] in the last two years of the study). Estimating the prevalence of those with non-AIDS human

immunodeficiency virus from metropolitan clinic registries, we found that the rate of hospitalization for community-acquired pneumonia increased in those with non-AIDS human immunodeficiency virus (from 0.6 percent [95% CI 0.3-0.9] in the first three years of the study to 1.9 percent [95% CI 1.3- 2.5] in the last two years of the study). Females comprised forty-one percent of the non-AIDS human immunodeficiency virus patients with pneumonia and twenty-two percent of the patients with AIDS. The majority of the human immunodeficiency virus positive patients with pneumonia had AIDS. Those with AIDS / non-AIDS human immunodeficiency virus resided and were hospitalized predominately in an urban region. The mean number of comorbidities and multiple discharges for pneumonia (Table 2) was higher in those with AIDS.

The all cause thirty-day re-admission rates were higher for AIDS patients compared to non-AIDS or human immunodeficiency virus negative patients. The in-hospital and one-year mortality rates were higher for AIDS patients. The yearly AIDS mortality rate for community-acquired pneumonia separations is shown in Figure 2. The in-hospital mortality rate for the AIDS patients was 21.2 percent during April 1,1994 to March 31, 1997 and decreased to 8.7 percent in the last two years of the study (April 1, 1997 to March 31,1999), while the one-year mortality rate for the AIDS patients was 64.3 percent and decreased to 40.7 percent during respective study periods.

By multivariate analysis (Table 3), the following were found to be associated with a prolonged length of stay – AIDS and non-AIDS human immunodeficiency virus, transfer to another acute hospital, special care unit admission, non-teaching metropolitan hospital, and comorbidity. Lower costs were associated with transfer to an acute hospital and more comorbidity. Hypotension/shock significantly increased the odds of in-hospital and one-year mortality. In addition, non-AIDS human immunodeficiency virus increased the odds of one-year mortality. Hospital re-admission was not associated with any of the covariates we considered.

DISCUSSION

AIDS status identified patients admitted for community-acquired pneumonia who manifested three times higher odds of a longer hospital length of stay and who had three and ten times higher odds for excess in-hospital and one-year mortality, respectively, compared to their matched controls. Similarly, non-AIDS human immunodeficiency virus status identified patients admitted for community-acquired pneumonia who manifested twice higher odds for a longer hospital length of stay and who had four times higher odds for excess one-year mortality than their matched controls. Hospital re-admissions were more frequent for those with AIDS compared to matched controls and those with

non-AIDS human immunodeficiency virus, but they did not reach statistical significance. The outcomes for community-acquired pneumonia were worse for those with non-AIDS human immunodeficiency virus / AIDS after matching for age and sex and controlling for severity of illness and comorbidity.

Hospitalizations for community-acquired pneumonia decreased for those with AIDS and increased for those with non-AIDS human immunodeficiency virus during the study period. We also noted temporal changes in the frequency of hospitalization for community-acquired pneumonia in those with non-AIDS human immunodeficiency virus / AIDS compared to their matched controls. Touchie and Marrie [19] matched thirty-two patients with non-AIDS human immunodeficiency virus / AIDS and pneumonia with thirty-three human immunodeficiency virus negative patients by age and sex, who required admission to hospital for the treatment of community-acquired pneumonia. This study was carried out in Halifax, Nova Scotia from September, 1991 through October, 1993. Fifty percent of the non-AIDS human immunodeficiency virus / AIDS patients had Pneumocystis carinii versus none of the human immunodeficiency virus negative patients. The in-hospital mortality rates were twenty-five percent and zero and the one-year mortality rates were seventy percent and six percent for the non-AIDS human immunodeficiency virus / AIDS patients and the human immunodeficiency virus negative patients, respectively. In the current study, the in-hospital mortality and one-year mortality rates for those with AIDS were 16.9 percent and fifty-nine percent and 2.2 percent and nineteen percent for those who were non-AIDS human immunodeficiency virus positive. Park et al. [20] studied one hundred and twelve human immunodeficiency virus positive and four hundred and ten human immunodeficiency virus negative patients admitted to the Harborview Hospital in Seattle from June, 1994 through May, 1996 with community-acquired pneumonia. Thirty-one percent of the human immunodeficiency virus positive patients had Pneumocystis carinii compared with none of the human immunodeficiency virus negative patients. Fourteen percent of the human immunodeficiency virus positive patients in the Park's study were female compared with twenty-seven percent in the current study. The in-hospital mortality rate for the human immunodeficiency virus positive patients was 8.9 percent compared with 3.7 percent for the human immunodeficiency virus negative patients in the Park's study [20]. One other study found that there was no significant difference in the in-hospital mortality between the human immunodeficiency virus positive patients at 10.6 percent and the human immunodeficiency virus negative patients at 7.8 percent [21].

We used an administrative database to study the temporal trends in pneumonia in human immunodeficiency virus infected persons in Alberta. Identification of those with non-AIDS human immunodeficiency virus / AIDS was dependent upon hospital abstraction. We did not verify the quality of hospital extraction which would have required sampling over 40,000 charts in over one hundred hospitals.

However, it was reasonable to assume that human immunodeficiency virus status may be well documented in hospital records. Population-based administrative database research is highly generalizable although limited in clinical details. We were unable to identify all those non-AIDS human immunodeficiency virus / AIDS individuals at risk for community-acquired pneumonia hospitalization. Published reports available from Health Canada are inconsistent with patients volumes treated within the two major non-AIDS human immunodeficiency virus /AIDS clinics in Edmonton and Calgary. We attempted to adjust for case severity (hypotension/shock, respiratory arrest/failure, ventilation, special care unit admission, export to another region, transfer to another hospital) and case mix (comorbidity, transfer from nursing home, age, sex) but may not have captured all variation [22]. These variables are likely less reliable than a clinically derived pneumonia index [23].

Notwithstanding these limitations, however, this particular study design also has strengths. We were readily able to determine the re-admission rate and the one-year mortality rate using population-based data. As well, we were able to estimate the cost of treatment. The cost of treatment of pneumonia for patients with AIDS was $1,571 higher per episode than that for human immunodeficiency virus negative patients. The cost for non-AIDS human immunodeficiency virus patients was similar to that of human immunodeficiency virus negative patients. After adjusting for severity of illness and comorbidity, the risk of hospital costs were similar in those with non-AIDS human immunodeficiency virus / AIDS and their matched controls.

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FIGURE LEGEND

Figure 1a shows the yearly discharges for AIDS and non-AIDS human immunodeficiency virus patients admitted with community-acquired pneumonia. The total number of patients discharged in the five study years from hospital for community-acquired pneumonia in the same age range (eighteen to sixty-seven years) varied from 4,454 to 3,391 discharges per year. Figure 1b shows the discharge rate for AIDS and non-AIDS human immunodeficiency virus patients in the first three years and last two years of the study. Because of the low numbers and introduction of highly active antiretroviral therapy in April, 1997, data were aggregated. Denominators were estimated from non-AIDS human immunodeficiency virus / AIDS registry census in the two metropolitan cities.

Figure 2 shows the mortality rate for AIDS patients admitted with community-acquired pneumonia..

Figure 1a – Yearly hospital discharges for AIDS and non-AIDS patient human immunodeficiency virus patients admitted with community-acquired pneumonia in Alberta

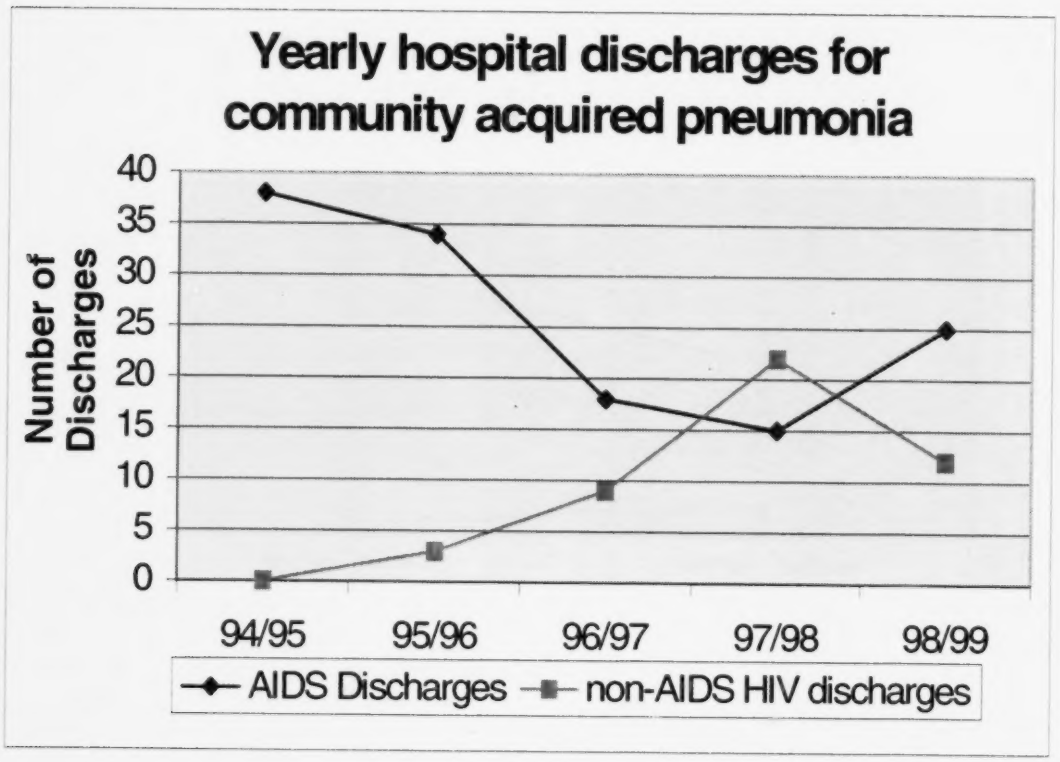

Figure 1b – Hospital discharge rate for AIDS and non-AIDS human immunodeficiency virus patients in the first three years and last two years of the study

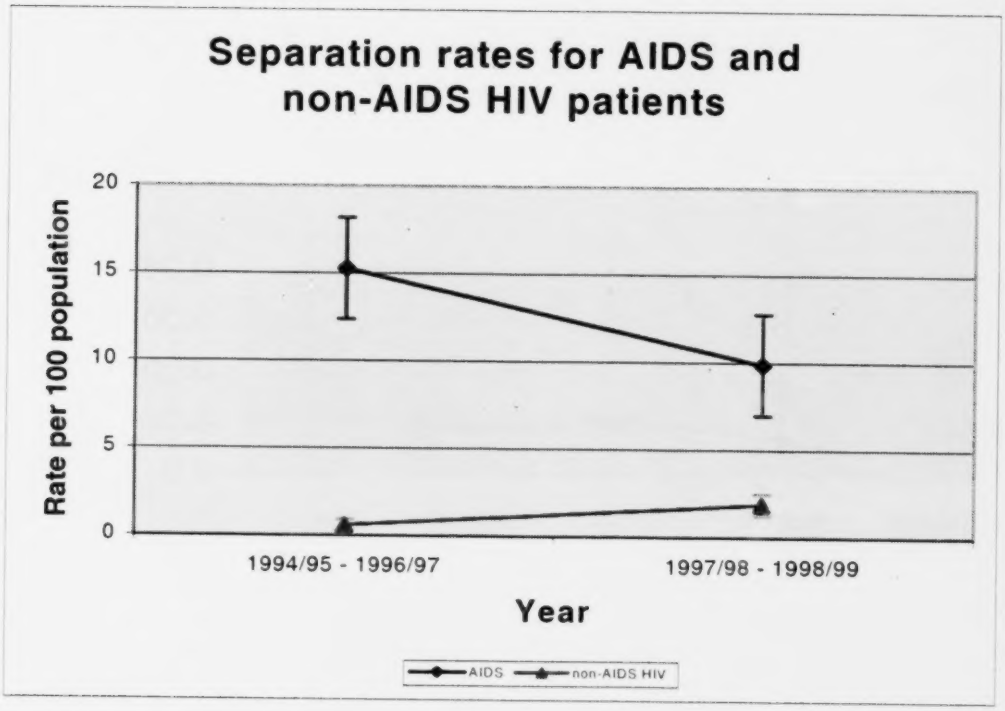

Figure 2 – Mortality rate for AIDS patients admitted with community-acquired pneumonia

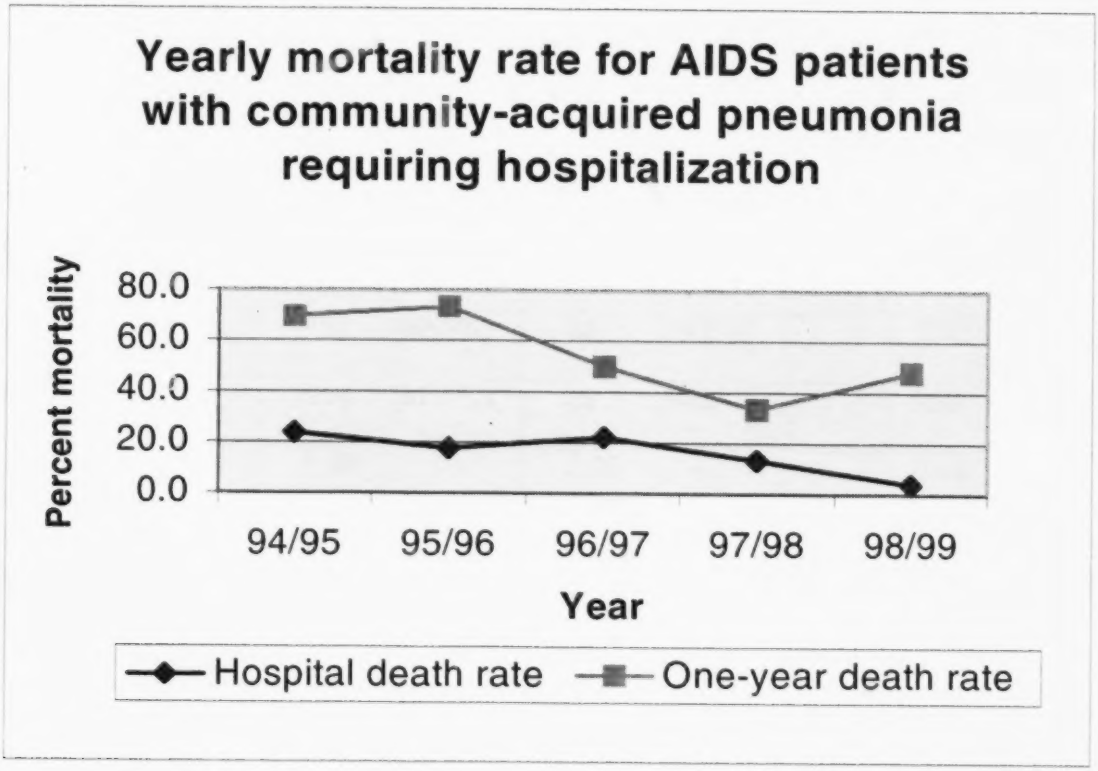

Table 1 – Patient group demographics for hospitalized community-acquired pneumonia in Alberta during 1994/95 to 1998/99

	Separations in those with AIDS n = 130	Separations in those with non- AIDS human immunodeficiency virus n = 46	Separations in those without AIDS or non -AIDS human immunodeficiency virus [1] n = 703
Female; n (%)	29 (22.3%)	19 (41.3%)	192 (27.3%)
Age (mean in years)	38.5	36.3	37.7
Urban region of residence; n (%)	107 (82.3%)	36 (78.3%)	274 (38.9%)
Urban region of service; n (%)	114 (87.7%)	39 (84.8%)	286 (40.3%)
Mean number of comorbidities	1.36	0.46	0.45
Mean use of special medical care [2]	0.21	0.22	0.19

[1] Comparative group is matched for age and sex
[2] Refers to any:
1) transfer from another acute care facility
2) special / intensive care unit admission
3) ventilation greater than ninety-six hours
4) in-hospital dialysis

Table 2 – Process of care for hospitalized community-acquired pneumonia groups in Alberta during 1994/95 to 1998/99

	Separations in those with AIDS	Separations in those with non- AIDS human immunodeficiency virus	Separations in those without AIDS or non- AIDS human immunodeficiency virus [1]
Separations; n	130	46	704
Unique persons; (n)	100	42	698
Separations per unique person; (%)	1.30	1.10	1.01
Mean (median) length of stay in days	9.9 (7)	7.3 (5)	5.4 (4)
All cause thirty-day re-admissions (excluding separations ending in deaths); n (%)	25 (23.1%)	5 (11.1%)	95 (14.0%)
In-hospital mortality; n (%)	22 (16.9%)	1 (2.2%)	26 (3.7%)
One-year mortality of Alberta residents; n (%)	76 (59.4%)	8 (18.6%)	57 (8.4%)
Average daily hospital costs (dollars)	$669	$601	$749
Average hospital costs per separation (dollars)	$6,629	$4,417	$4,058

[1] Comparative group in matched for age and sex

Table 3 – Odds ratios and their ninety-five percent confidence intervals on four outcomes by hospitalized community-acquired pneumonia groups in Alberta during 1994/95 to 1998/99

	Length of stay > median of six days	Hospital cost > median of $637.72	Thirty day re-admissions	In-hospital mortality	One-year mortality
AIDS	3.0 (1.68-5.36)	0.99 [1] (0.59-1.69)	NS	3.39 (1.32-8.70)	10.09 (4.78-21.33)
non- AIDS human immunodeficiency virus	2.12 (1.02-4.40)	0.79 [1] (0.41-1.5)	NS	0.83 [1] (0.07-9.76)	4.33 (1.36-13.82)
Transfer to acute hospital	4.43 (1.40-14.07)	0.30 (0.11-0.79)	NS	NS	NS
Special / intensive care admission	2.98 (1.55-5.73)	NS	NS	NS	NS
Rural hospital (50 to 108 cases per year)	0.36 (0.016-0.81)	NS	NS	NS	NS
Regional hospital	1.57 (0.77-3.20)	NS	NS	NS	NS
Urban hospital (metropolitan)	2.27 (1.22-4.23)	NS	NS	NS	NS
Urban hospital (hospitals in proximity to a medical school metropolitan)	1.96 (0.98-3.92)	NS	NS	NS	NS
Comorbidity (1)	1.44 (0.88-2.35)	1.89 (1.26-2.83)	NS	2.24 (0.68-7.33)	4.54 (1.85-11.15)
Comorbidity (2)	2.24 (1.11-4.53)	1.53 (0.86-2.74)	NS	7.81 (2.21-27.51)	19.53 (6.80-56.07)
Comorbidity (> 2)	3.86 (1.04-14.33)	1.59 (0.56-4.53)	NS	39.15 (3.42-448.78)	25.60 (5.0-131.01)
Hypotension / shock	NS	NS	NS	8.70 (1.88-40.28)	11.93 (2.65-53.61)

[1] We forced non-AIDS human immunodeficiency virus / AIDS in the final model even when they are not significant

BIOGRAPHIES

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As a physician, Dr. David Johnson's clinical practice is affected by the health care system. Dr. Johnson is interested in understanding and promoting the use of information in directing health policy formation and decision-making by the managers of the health care system.

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Dr. Carrière's areas of research include multivariate methods, design and analysis of repeated measures data, missing data, and multivariate Behrens-Fisher problems. Dr. Carrière's area of application is in health services research, where her contribution in this area led her to win the National Health Scholar Award (1996-2001) from the National Health Research and Development Program (NHRDP). She is a Senior Scholar with Alberta Heritage Foundation for Medical Research (AHFMR) (1999-2004) and is currently funded by the following organizations; NSERC, MRC, NHRDP, AHFMR, and NCIC.

Dr. Carrière is an elected board member of the Western North American Region of International Biometrics Society (2000-2002), a past member of its regional advisory board, and past elected executive member for the Section on Health Policy Statistics of the American Statistical Association (1999-2001). Dr. Carrière organized and chaired as well as invited and contributed paper sessions at major national and international conferences, including the recent Edmonton Statistics and Health conference in June, 2000.

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Major responsibilities include managing health protection programs and monitoring and reporting on the health status of the population. Annually, Dr. Predy produces a health status report entitled "How Healthy Are We?" which makes use of population health indicators and the influence of the determinants of health.

Leading an initiative to address three priority issues in population health including heart disease/stroke, injury control and addressing the health needs of an aging population. Two additional priorities of low birth weight and healthy weights have been added recently.

Dr. Predy has a limited practice in a local medical clinic.

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Since 1989, Dr. Shafran has been a member of the Division of Infectious Disease, Department of Medicine at the University of Alberta. In 1998, he was promoted to Professor and Director of the division. His major clinical interests are human immunodeficiency virus infection and chronic viral hepatitis. His major research interests are new antimicrobial therapies, particularly antiviral agents. He is a Past President of the Canadian Infectious Disease Society.

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Dr. Marrie's major research interest is in the area of community-acquired pneumonia. Over the years this focus has evolved from laboratory based research to a population health basis. Dr. Marrie's interest is in understanding the variation that occurs in the treatment of pneumonia and finding ways to minimize this variation.

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